CLAIMS

What we claim:

1. A rain attenuation compensation method using adaptive transmission technique in a satellite communication system including a transmission end using a plurality of transmission methods combining an adaptive coding method and an adaptive modulation method, a receiving end using a plurality of receiving methods combining an adaptive decoding method and an adaptive demodulation method, and a controller for estimating/predicting signal-to-noise (S/N) ratio and controlling both the transmission method and transmission power of the transmission end and the receiving method of the receiving end, characterized in that the controller performs a rain attenuation compensation comprising the steps of:

estimating a signal-to-noise(S/N) ratio of present time point, and predicting a signal-to-noise(S/N) ratio of the next time point;

determining a transmission method which is adequate to the predicted signal-to-noise (S/N) ratio of the next time point; and

generating a control signal for requesting the change of the transmission method and transmission power of the transmission end and the receiving method of the receiving end according to the determined transmission method, and transmitting/receiving a data through the changed transmission method.

2. The rain attenuation compensation method using adaptive transmission technique according to claim 1 wherein the step of estimating the signal-to-noise (S/N) ratio of the present time point in the step of predicting the signal-to-noise (S/N) ratio comprises the steps of:

performing a normalization according to the modulation method of received symbols;

obtaining a histogram of the normalized symbol values;

obtaining linear combination result by applying a square-type weights on the histogram; and

estimating the received signal-to-noise (S/N) ratio from the linear combination result.

3. The rain attenuation compensation method using adaptive transmission technique according to claim 2 wherein the step of performing the normalization comprises the steps of:

determining a normalization reference level according to a control signal indicating the modulation method of a received signal; and

multiplying an inverse number of the normalization reference level by the received signal, and performing a normalization.

4. The rain attenuation compensation method using adaptive transmission technique according to claim 2 wherein the step of obtaining the histogram comprises the steps of:

calculating an absolute value of the real part or the imaginary part of the received symbols;

performing quantization operations with a predetermined quantization levels; and

observing the number of symbols included in each quantization level, and estimating the histogram.

5. The rain attenuation compensation method using adaptive transmission technique according to claim 2 wherein the step obtaining the linear combination result comprises the steps of:

symmetrically multiplying the symbol values by weights of squared integers such as 0, 1, 4, and 9 et al. with the normalized symbol level in the center; and

adding all of the results obtained by multiplying the weight values, and thus calculating the linearly combined value.

6. The rain attenuation compensation method using adaptive transmission technique according to claim 2 wherein the step of estimating the received signal-to-noise (S/N) ratio comprises the steps of:

making a table for representing the relationship between the linear combination result value and the received signal-to-noise (S/N) ratio obtained by simulation; and

estimating the received signal-to-noise (S/N) ratio on the basis of a linear combination result value calculated with respect to a channel by using the relation table.

7. The rain attenuation compensation method using adaptive transmission technique according to claim 1 wherein the step of predicting the signal-to-noise (S/N) ratio at the next time point comprises the steps of:

performing a low-pass-filtering for removing high-speed variation of the magnitude of the estimated signal-to-noise (S/N) ratio;

predicting the magnitude of the signal-to-noise (S/N) ratio after a predetermined time on the basis of the variation of the low-pass-filtered signal-to-noise (S/N) ratio;

estimating an average prediction error of the predicted value;

correcting an prediction error of the predicted signal-to-noise (S/N) ratio; and

allocating an prediction margin to the prediction value for which the prediction error is corrected.

8. The rain attenuation compensation method using adaptive transmission technique according to claim 7 wherein:

the step of predicting the signal-to-noise (S/N) ratio predicts the magnitude of a signal-to-noise (S/N) ratio after a predetermined time from the variation amount of a predetermined degree for a difference between the received signal-to-noise (S/N) ratio at the past time point and the received signal-to-noise (S/N) ratio at the present time point.

9. The rain attenuation compensation method using adaptive transmission technique according to claim 7 wherein the step of correcting the prediction error of the predicted signal-to-noise (S/N) ratio comprises the steps of:

delaying the predicted signal-to-noise (S/N) ratio by an predetermined prediction time;

estimating the difference between a real received signal-to-noise (S/N) ratio before the low pass filtering and the delayed signal-to-noise (S/N) ratio, and obtaining the prediction error;

estimating an average prediction error; and

correcting the predicted value of signal-to-noise (S/N) ratio by adding a correction value proportional to the average prediction error.

10. The rain attenuation compensation method using adaptive transmission technique according to claim 9 wherein:

the step of estimating the average prediction error obtains the average prediction error by applying a discrete-time feedback filtering on the prediction error.

11. The rain attenuation compensation method using adaptive transmission technique according to claim 7 wherein the step of allocating the prediction margin comprises the steps of:

estimating a standard deviation of prediction error on the basis of the prediction error and the average prediction error;

estimating a variable prediction margin to be proportional to the standard deviation; and

adding both the variable prediction margin and a predetermined fixed prediction margin to the predicted and corrected signal-to-noise (S/N) ratio.

12. The rain attenuation compensation method using adaptive transmission technique according to claim 11 wherein:

the step of estimating the standard deviation of prediction error obtains a standard deviation of an prediction error by applying a discrete-time feedback filtering on the difference between the prediction error and the average prediction error.

13. The rain attenuation compensation method using adaptive transmission technique according to claim 11 wherein:

the step of estimating the variable prediction margin obtains the variable prediction margin by using a constant proportional to a difference between a time rate and a required probability, the time rate causing a negative (-) prediction error until a present time point.

14. The rain attenuation compensation method using adaptive transmission technique according to claim 1 wherein the step of determining the transmission method comprises the steps of:

estimating a slope from the signal-to-noise (S/N) ratio values at the past and present time points, and estimating a accumulation parameter for adjusting a accumulation weighting value according to the slope;

estimating transmission efficiency of the present signal-to-noise(S/N) ratio for each transmission method;

estimating a cumulative transmission efficiency by using the calculated transmission efficiency and the accumulation parameter for each transmission method; and

selecting a transmission method having the maximum cumulative transmission efficiency, determining whether the selection is stable or not, and determining a switching toward the selected transmission method according to the determined result.

15. The rain attenuation compensation method using adaptive transmission technique according to claim 1 wherein:

the transmission method is an adaptive transmission method comprising an adaptive coding using a block turbo code and an adaptive modulation using M-ary PSK modulation.

16. The rain attenuation compensation method using adaptive transmission technique according to claim 15 wherein the adaptive coding using the block turbo code constructs an information frame having k^2 bits in order to employ (n,k) linear block code wherein a length of information word is 'k' and a length of a code word is 'n', whereby

in a normal case, the transmission end performs k-times block coding operations with respect to k information bits and transmits a coding frame having nk bits; and the receiving end sequentially performs soft decision Viterbi decoding operation for k times as to n received signals at a time with respect to nk received signals, thereby restoring a plurality of information frames of k^2; and

if it is determined that an additional coding gain is needed because of an excessive attenuation, the transmission end performs block coding operations for k times for each row and column as to k information bits and transmits coding frames having $(2nk-k^2)$ bits; and the receiving end performs iterative decoding operations by using a soft decision output Viterbi algorithm about a received coding frame having $(2nk-k^2)$ bits, thereby restoring a plurality of information frames of k^2.

17. The rain attenuation compensation method using adaptive transmission technique according to claim 14 wherein:

the transmission efficiency is estimated by using a predetermined required signal-to-noise (S/N) ratio value for each transmission method.

18. The rain attenuation compensation method using adaptive transmission technique according to claim 14 wherein the step of estimating the cumulative parameter comprises the steps of:

estimating a slope on the basis of a difference between the past signal-to-noise (S/N) ratio and the present received signal-to-noise (S/N) ratio;

updating the present signal-to-noise (S/N) ratio to the past signal-to-noise (S/N) ratio, and recording the updated signal-to-noise (S/N) ratio; and

estimating the accumulation parameter from the slope, to be inversely proportional to the slope.

19. The rain attenuation compensation method using adaptive transmission technique according to claim 14 wherein the step of determining a conversion toward the selected transmission method comprises the steps of:

selecting a transmission method having a maximum transmission efficiency among the cumulative transmission efficiencies;

determining whether or not the selected transmission method is one with higher priority than that of the past transmission method; and

performing a switching toward the selected transmission method when the selected transmission method does not have a higher-priority, and if the determined method has a higher priority, performing a switching toward the selected transmission method when the same selection is made for a continued period of time.

20. A recording media readable by a computer containing a program therein, the program makes the computer to perform the steps of:

estimating a signal-to-noise (S/N) ratio of a preset time point, and predicting a signal-to-noise (S/N) ratio of the next time point;

determining which of transmission methods is adequate to the predicted signal-to-noise (S/N) ratio of the next time point; and

generating a control signal for inquiring the change of the transmission method and transmission power of the transmission end and the receiving method of the receiving end according to the determined transmission method, and transmitting/receiving a data through the changed transmission method.

21. A satellite communication system comprising:

a transmission end comprising a plurality of transmission methods composed of the combination of an adaptive coding and an adaptive modulation;

a receiving end comprising a plurality of receiving methods composed of a combination of an adaptive decoding and an adaptive demodulation; and

a controller which estimates a signal-to-noise (S/N) ratio of the signal received at the receiving end, predicts a signal-to-noise (S/N) ratio at the next time point, determines which of transmission methods is adequate to the predicted signal-to-noise (S/N) ratio of the next time point, controls both the transmission method and transmission power of the transmission end and the receiving method of the receiving end so as to allow the transmission end and the receiving end to transmit/receive the data through the determined transmission method, and adaptively controls the transmission method according to the signal-to-noise (S/N) ratio.